



Product-Service Systems across Life Cycle

The influence of ownership on the sustainable use of product-service systems - A literature review.

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* Corresponding author. Tel.: +32 479 736 986; E-mail address: klara.demyttenaere@student.uantwerpen.be**Abstract**

The evolution towards sustainable product service systems introduces a new relationship between product and user in PSS, where we see that the user no longer is the legal owner of the product. This article reports upon an exploration of the psychological relationship between consumer and product within the context of PSS, and addresses the way a shift in ownership influences consumers' perception. A literature review was needed towards the psychological side of the consumer-product relationship and its relation to different research fields (product attachment, experience design and non-ownership modes of consumption). The result is a set of characteristics that describes the system and the ownership dimensions. This set of characteristics could lead to future research into the correlation of different characteristics, ultimately leading to a set of guidelines for designers designing new PSSs.

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Abbreviations

PSS Product-service system

1. Introduction

The evolution of traditional products to product-service systems (PSS) is a valuable strategy for making a shift to sustainable consumption both for the people, planet and profit aspect. These PSS often results in non-ownership modes of consumption, such as renting, leasing or sharing. In this research, we focus on the new consumer-product relationship, which is marked by shifts in property rights, responsibility and the temporality of possession. The nature of this altered relationship is important because not all PSSs automatically lead to sustainable solutions [1], [2]. This level of sustainability depends on a lot of influencing factors. The shift in ownership, meaning that the user is no longer the legal owner of the product, is one of these factors. Non-ownership modes of consumption are presented to be collaborative, prosocial, altruistic and environmentally sustainable [3], but previous

research has shown that this is not always the case [4]. The shift in ownership, firstly, has the potential to make the PSS more sustainable by incentivising companies to make better products and the decreased amount of products that is needed to satisfy the same amount of consumers [5], [6]. Secondly, it can help changing the consumers' idea that ownership is the only option. Ownerless consumption has been identified as a trend over the past few years, meaning that consumers are willing to change their consumption pattern [7], although mainly for their own benefit [8]. Nonetheless, this shift in ownership has also been identified as a possible origin of rebound effects [1], [9]. Rebound effects turn a potential sustainable solution into an eventual increase of resource consumption [10]–[13]. Rebound effects linked to consumer behaviour are influenced by the shift in ownership. When consumers are no longer the owner of the product they might exhibit careless behaviour concerning the product [1], [4]. These types of behaviour can compromise the sustainability of the whole PSS and should be precluded, therefore it is of extreme importance to investigate the psychological relationship between a user and the product or PSS. The reasoning model behind this paper is based on the assumption that adding a service to a product that solely

focusses on a shift in property rights, responsibility or the temporality of possession, can decrease the (perceived) value of that product for the user, which can result in rebound effects. If this added service on the other hand goes beyond this pure functionality it can increase the (perceived) value of that product. Besides this it is important to note that this research does not see the tangible product and intangible service as two independent factors and mainly focusses on the difference in ownership between product and PSS and its influence on the psychological relationship between users and product. Therefore, the term product will be used while describing the different fields, but also refers to PSSs

Fields of research into consumer-product relationship such as product attachment and experience design, shed a new light on how this relationship can be designed to be more sustainable. This article explores a state of the art of the techniques from the different fields to make the consumer-product relationship more meaningful and long-lasting. This literature review results in a set of characteristics, describing ownership in the case of PSS.

2. Literature review

This review will first of all briefly describe the concept of PSS, the shift in ownership in PSSs and its possible rebound effects.

Secondly, ownership is analysed and examples of non-ownership modes of consumption are discussed. Thirdly, two fields of research proposing new ways of designing consumer-product relationships are discussed; product attachment and experience design. This section delineate a state of the art of the different fields in apropos the (psychological) relationship.

2.1. Product-service systems

Tukker and Tischner define product services as “mixes of tangible products and intangible services designed and combined so that they jointly are capable of integrated, final customer needs. The system is defined as the network, infrastructure and governance structure needed to ‘produce’ a product-service” [14]. This definition acknowledges that the products and services in a PSS are inseparably linked, but also that not all PSSs offer the same ratio between product and service since this highly depends on the offering. Based on this ratio the range of PSSs can be divided in three main categories; product-, use-, and result-oriented PSS, and subcategories (see figure 1a). The product-oriented PSSs are still mainly focused on the sale of products and offering services supporting that product, while the result-oriented PSSs are purely focussed on selling the result and solely use products to get that result.

The European Commission also gave a definition of PSSs and

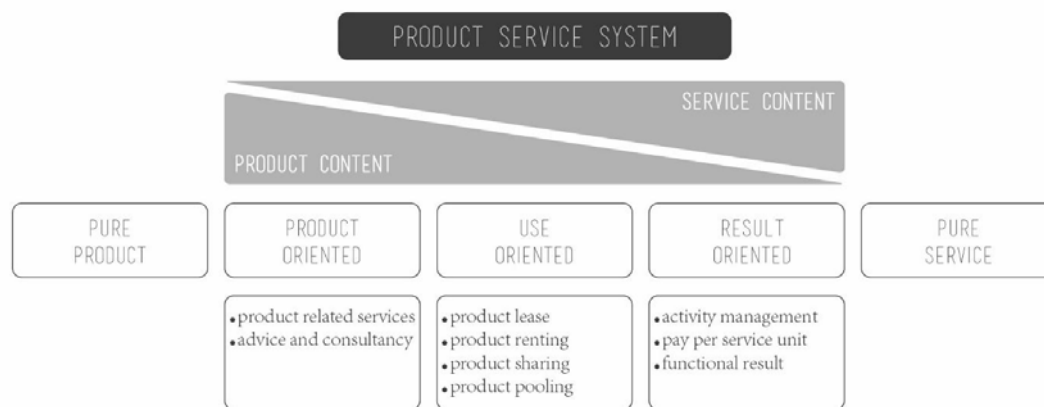


Figure 1a; Main and subcategories PSS (Tukker 2004)



Figure 1b; Shift in property rights



Figure 1c; Shift in responsibility

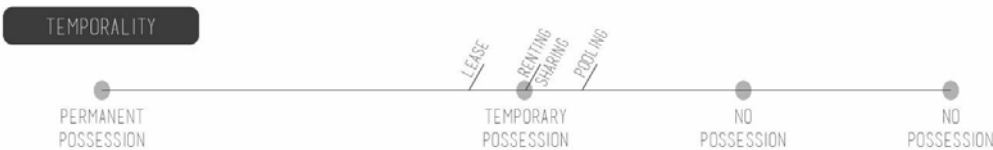


Figure 1d; Shift in temporality

interprets PSSs as ways to “fulfil functions and provide services to end users without necessarily transferring the ownership of the product to them” [15]. This definition emphasises the shift in ownership. Hockerts and Weaver [16] follow this approach, mainly focussing on the shift in property rights. They only speak of product-services when the property rights related to a product are distributed between user and provider (see figure 1b). The distribution of property rights can closely be linked to the type of PSS offered. If a PSS is service-oriented we generally see that the property rights of the consumer decrease compared to product-oriented PSSs. The shift in property rights is traditionally also linked to a shift in responsibility [17], thus we see that a change in property rights changes the responsibility a consumer has over the product, PSS or service. We notice, for example, that if we are talking about services, a consumer has no property rights and traditionally has no responsibility (see figure 1c). Instead of merely focussing on a shift in ownership we can argue that there is also a shift in the temporality of possession depending on the type of PSS (see figure 1d). Where, in contrast to the long-term interaction with an object associated with ownership, in access, possession is more temporary [18].

The sustainability of PSSs is a topic of discussion in the academic field. Some authors link PSS inherently to sustainability [6], [19], [20], while some do not. According to the UNEP, a PSS is only sustainable when it assists in re-orienting current unsustainable trends in production and consumption practices into sustainable trends [1]. Meaning that although PSSs have the potential to be sustainable, they not always are. It can even be said that some PSSs could generate unwanted side effects, which we call rebound effects [1].

Summing up, we defined some characteristics that will be important to distinguish among the wide range of PSSs, these characteristics are; (1) *the degree of product-or service-orientation*, (2) *the responsibility of the consumer for the PSS* and (3) *the temporality of ownership*. The other characteristics, defining the relationship between the consumer and the product, will be elaborated in the next sections.

2.2. Ownership

Ownership cannot be described by one definition, because of its wide ranging connotation. Etzioni [21] also observed ownership to be a “dual creation, part attitude, part object, part in the mind, part ‘real’”. Therefore a distinction between legal and psychological ownership is introduced. Legal ownership and psychological ownership are used to distinguish between the two parts of ownership identified by Etzioni, legal ownership is the “real” part and psychological ownership is the part in the mind.

Legal ownership “is the ultimate and exclusive right conferred by a lawful claim or title, and subject to certain restrictions to enjoy, occupy, possess, rent, sell, use, give away, or even destroy an item of property. [...] Possession (as in tenancy) does not necessarily mean ownership because it does not automatically transfer title.” [22].

Psychological ownership [23] is defined as the state of mind in which individuals feel that the target of ownership (which can be material or immaterial), or a piece of it is “theirs”. The foundation of this feeling is the feeling of possessiveness and the feeling of having a psychological bond with the object [24]. Pierce et al. [25] propose three actions that can lead to

psychological ownership; controlling the object, coming to know the object intimately and investing the self into the target. Previous research into the field of non-ownership modes of consumption already pointed out that there is a change in the perception and behaviour of consumers compared to traditional ownership. A study simulating two different acquisition modes of a PSS, identified a difference in responsibility depending on the acquisition mode. When the consumer thinks the product is his own property, because of the acquisition mode, he was found to take better care of it [4]. This underlines the influence of the mere-ownership effect [26] on psychological ownership. The mere-ownership effect is the effect describing that an owner will evaluate an object more favourably than a non-owner [27]. A study on access-based consumption that rejected the idea of non-ownership modes of consumption unconditionally being altruistic, prosocial and sustainable, backs the finding that the type of relationship between the user and product has a big influence on the perceived value of the PSS. They identified six dimensions to categorise among the range of access-based consumption modes. These dimensions also influence the type of consumer-product relationship: temporality, anonymity, market mediation, consumer involvement, the type of accessed object, and political consumerism [3]. Similar to this, a study on the perception of smart PSSs surfaced, the word ‘smart’ outlines the presence of an important ICT component in the PSS. The study defined six characteristics that influence the perception of the smart PSSs; consumer empowerment, individualisation of services, community feeling, service involvement, product ownership and individual/shared experience [28].

To conclude, we make a distinction between legal ownership and psychological ownership and underline the importance of psychological ownership due to the influence of the mere-ownership effect. A few characteristics are identified as being influential on the perception of non-ownership modes of consumption. A part of these characteristics are withheld in our research; (1) *legal ownership*, (2) *psychological ownership*, (3) *temporality*, (4) *anonymity*, which also entails the community feeling, (5) *consumer involvement and consumer empowerment* and (6) *the type of accessed object*, including the individualisation of services, the service involvement and the individuality of the experience.

2.3. Product attachment

Product attachment is defined as the strength of the emotional bond a consumer experiences with a specific product [29]–[31]. Attachment thus implies the existence of a strong emotional relationship or tie between the consumer and an object [30], [31]. The object to which a consumer is attached is considered to be special and usually means a lot to that consumer [31]. Product attachment is also a matter of degree [32]. A consumer does not feel the same degree of attachment to all of her/his belongings. Consumers may experience stronger emotional bonds with their most favourite or special belongings, and lesser to other products [30].

Individuals are not found to deliberately seek to develop attachment to particular objects [30]. Attachment results from a personal history between the consumer and the object [32], and the feeling of attachment develops over time as a result of multiple recurring interactions between the consumer and the object [30]. Attachments are also formed by the personal and

special meaning the object conveys, rather than by its pure functionality [33], since attachments are extensions of the self [32]. The recurring interactions from which attachment can arise usually take place over the whole possession period and, although they are mainly functional actions such as using, cleaning and storing, referred to as possession rituals by McCracken [34], these interactions help to accumulate special meaning and they allow the consumer to claim that product as hers/his. Another way of obtaining personal and special meaning is making the product transcend its purely utilitarian meaning, thus providing the owner with something exceptional [30], [35].

The feeling of attachment and the resulting special meaning linked to the object, makes the object extraordinary for the consumer [32]. This makes the consumer not wanting to lose or detach from the object, since the consumer feels that the special meaning that is conveyed by the product, they are attached to, would be lost as well [30], [35]. As a result of this feeling consumers will try to keep the object to which they feel attached for as long as possible and they will exhibit protective behaviour towards these objects [30], [35], [36]. This feeling of being attached and emotionally bound to an object makes the consumer postpone its replacement and take better care of the object, because the consumer cherishes the relationship with the object and wants to preserve it [30], [35]. This is beneficiary for the sustainability with regard to this product, leading to a longer lifespan. Used as a sustainability strategy it differs from others because it does not explicitly demands consumers' involvement for a sustainable society [35]. This strategy has the potential to be more successful, because the motivation to preserve the object comes from intrinsic motivation.

In short, product attachment addresses the emotional bond between users and objects. The existence of such an emotional relationship results in protective behaviour and thus stimulates the responsibility a person feels for a product, and by extension for a PSS. By adding special meaning to the PSS and making it more than purely functional or by stimulating recurring interactions, product- or PSS-attachment can arise and make a user behave protective over the PSS. The concept of product attachment is related to the concept of psychological ownership. Product attachment is focusing on the emotional bond between consumer and product and psychological ownership focusing on the psychological bond. The degree of product attachment and the degree of psychological ownership will be combined into one characteristic for this research. Characteristics withheld from this section are closely related to characteristics already named in the previous section; (1) *the degree of special meaning* is one of the characteristics defining what type of PSS will be accessed and whether or not an interaction is recurring will depend on (2) *the temporality of the PSS*.

2.4. Experience design

Experience and experience design are concepts with a rich history and meaning [37], [38]. We use Hassenzahl's definition of experiences, understanding an experience as "an episode, a chunk of time that one went through—with sights and sounds, feelings and thoughts, motives and actions (...) closely knitted together, stored in memory, labelled, relived, and communicated to others. An experience is a story, emerging from the dialogue of a person with her or his world

through action" [39]. It is only after going through this episode that people add meaning to the experience and that they can tell whether the experience was positive or negative [38]. Hassenzahl et al. [38] propose meaningful and positive experiences as a way to replace ownership and make life more meaningful. These positive and personally meaningful experiences most often arise from fulfilling psychological needs.

Experiences are not formed by entertaining users, but by involving them. Experiences can engage users on different dimensions and levels. Two of the most important ones, defined by Halfon [40], are user participation and the connection or environmental relationship. Experiences become most valuable to the user when the user is immersed in the experience and when she/he participates in an active way. By participating actively she/he can then personally influence the performance and alter the event that makes the experience [40]. Concluding, we can say that experiences have the possibility to fill in the lack of ownership. To do so it is important to design experiences that are personally meaningful and positive. To make experiences personally meaningful users should be involved in the experience by participating in an active way and by being immersed in the experience. *The level of user participation*, which includes consumer involvement and consumer empowerment, will be one of the characteristics defining the PSS.



Figure 2: Characteristics discussed in the literature review

3. Discussion and conclusion

PSSs have been an important trend in the past few years. However, the shift in ownership often associated with PSSs has not been researched enough and information about the way designers can fill in the gap that this shift might cause for

consumers remains inexistent. Ownership is still the dominant mode of consumption [3], and alternative consumption modes where the user is no longer the legal owner of the product are often associated with rebound effects, undermining the possible sustainable effects of the PSS.

The result of this paper is a set of eight characteristics, withheld from the literature study, with a specific focus on the psychological relationship between user and product. These characteristics are the ones emerging in different researches in the investigated fields. These characteristics are divided in two groups; the first group describes the system (analogous to the type of accessed object) and is characterised by (1) the degree of product- and service-orientation, (2) the degree of special meaning and (3) the degree of functionality. The second group describes the ownership dimensions, characterised by (4) psychological ownership, (5) user participation, (6) temporality, (7) anonymity and (8) responsibility. These characteristics are divided in two main groups; the system and the ownership dimensions. Some of the characteristics are described by multiple parameters, resulting in a total of sixteen parameters for the eight characteristics (see Figure 3 for an overview).

3.1. The system

Product-oriented vs service-oriented; the product component in a PSS is the tangible product. The service component of a PSS is mainly intangible in nature and has a high degree of flexibility, customisation and optimisation. They will vary depending on who is using the service. *Functionality*; the functionality of the PSS depends on the kind of need the PSS meets. We make the distinction between basic needs, psychological needs and self-fulfilment needs as defined by Maslow in his hierarchy of needs. *Special meaning*; the degree of special meaning a product conveys is defined by the degree a person adds personal (emotional) information to the PSS.

3.2. The ownership dimensions

The ownership dimensions are characteristics influenced by the fact that a person is no longer the legal owner of the product she/he is using.

Psychological ownership – product attachment; the degree of psychological ownership is the extent to which the user regards the product as his own. *User participation*; User participation is defined as the extent of influence the user can exert on the use, result or performance of the PSS. *Temporality*; the temporality of a PSS consists of three parameters; the period of ownership, the frequency of ownership and the frequency of use during ownership. The period of ownership is the period that the product is in the possession of the user. The frequency of ownership is the frequency that the product is possessed and not possessed by the user. The frequency of use during the ownership is the frequency that the product is used by the user, while in the possession of the user. *Anonymity*; the anonymity of the PSS is divided in two sub categories, anonymity between users and anonymity to the service provider. *Anonymity between users*; the anonymity between users defines the degree of anonymity between the different users of the same PSS. This anonymity is described by three parameters; the amount of users using the PSS, the amount of contact points between the users and the presence of a community. The amount of contact

points between the users is the amount of contact different users have with each other, this can be both physical and virtual. The presence of a community is also noted. *Anonymity to the service provider*; the anonymity to the service provider is the anonymity of the user towards the service provider. This anonymity is also defined by three parameters; user information, privacy of the use context and social control. The user information is the amount of information the service has about the user that can be directly linked to the use of the product. The privacy of the use context describes how private the environment is in which the product is used. The amount of social control is the amount of people witnessing the user using the product. *Responsibility*; the responsibility towards the PSS is described by two parameters; responsibility of the life cycle and responsibility of the life cycle cost. The responsibility towards the life cycle is the feeling the user has to be responsible for the life cycle of the product. It can be said that this includes the social and ecological responsibility. The responsibility towards the life cycle cost is the direct responsibility of the user regarding the costs attached to the life cycle of the product (repair, maintenance,...), this can also be described as the economic responsibility.

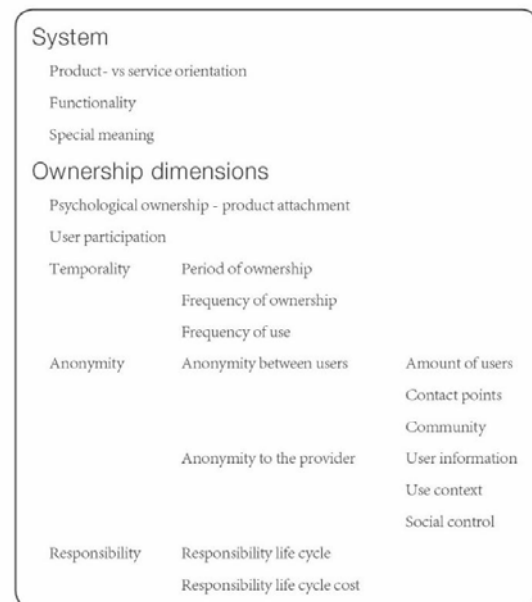


Figure 3: The set of characteristics and parameters

4. Future research

This study unravels ownership in the context of PSS. We have defined a set of characteristics describing ownership. In future research these characteristics could lead to a deeper analysis of existing PSS cases, resulting in an exploration of the relationship between the afore-mentioned characteristics. The ultimate outcome is a set of guidelines for designers, facilitating the design process of sustainable PSSs.

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